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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

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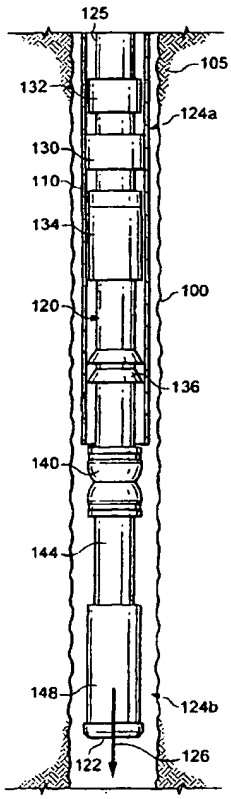
(54) Title: MONO DIAMETER WELLBORE CASING



(57) Abstract: An apparatus (120) and system for radially expanding and plastically deforming an expandable tubular member (110) where the system comprises an anchoring mechanism (148) adapted to mate with an end of the expandable tubular member (110), a tubular member (125) releasable coupled to the anchoring mechanism (148) \, an adjustable expansion mandrel (140), and an actuator (134) coupled to the adjustable expansion mandrel (140) to controllably longitudinally displace the adjustable expansion mandrel (140) relative to the expandable tubular member (110). The expansion mandrel (140) is controllably expanded to a larger diameter for radial expansion of the expandable tubular mandrel (110) or collapsed to a smaller outside diameter.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/14153

A. CLASSIFICATION OF SUBJECT MATTER
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US CL : 166/384
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 166/277,381,382,384,386,387,297,55,206,207,212,216,217,242.2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,012,523 A (Campbell et al.) 11 January 2000 (11.01.2000), columns 3 and 4.	1-3,7-12
Y	US 4,848,459 A (Blackwell et al.) 18 July 1989 (18.07.1989), see Figure 1.	1-3,7-12
A	US 6,112,818 A (Campbell et la.) 05 September 2000 (05.09.2000), see Abstract.	1-12
A, P	US 6,425,444 B1 (Metcalfe et al.) 30 July 2002 (30.07.2002), see Abstract.	1-12
A, P	US 6,631,765 B2 (Baugh et al.) 14 October 2003 (14.10.2003), see Abstract.	1-12
A	US 3,785,193 A (Kinley et al.) 15 January 1974 (15.01.1974), see Abstract.	1-12
A	US 6,021,850 A (Wood et al.) 08 February 2000 (08.02.2000), see Abstract.	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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INTERNATIONAL SEARCH REPORT

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Continuation of B. FIELDS SEARCHED Item 3:
EAST
search terms: expand, anchor, packer, valve, groove, grip

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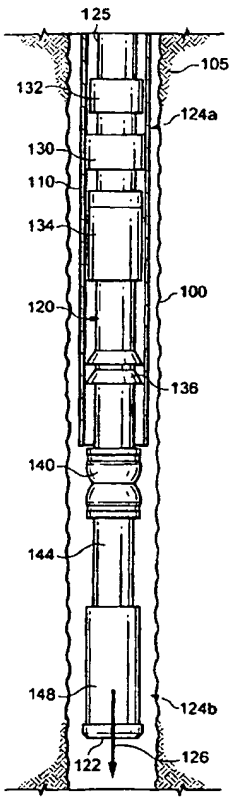

(57) Abstract: An apparatus (120) and system for radially expanding and plastically deforming an expandable tubular member (110) where the system comprises an anchoring mechanism (148) adapted to mate with an end of the expandable tubular member (110), a tubular member (125) releasable coupled to the anchoring mechanism (148) \, an adjustable expansion mandrel (140), and an actuator (134) coupled to the adjustable expansion mandrel (140) to controllably longitudinally displace the adjustable expansion mandrel (140) relative to the expandable tubular member (110). The expansion mandrel (140) is controllably expanded to a larger diameter for radial expansion of the expandable tubular mandrel (110) or collapsed to a smaller outside diameter.

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AMENDED CLAIMS

[Received by the International Bureau on 27 July 2004 (27.07.04): new claims 13-60 has been added (9 pages)]

13. (New) An apparatus for radially expanding and plastically deforming an expandable tubular member, comprising:

an anchoring mechanism adapted to mate with an end of the expandable tubular member;

a tubular member releasably coupled to the anchoring mechanism,

an adjustable expansion device coupled to the tubular member adapted to be controllably expanded to a larger outside dimension for radial expansion of the expandable tubular member or collapsed to a smaller outside dimension;

an actuator coupled to the adjustable expansion device adapted to controllably longitudinally displace the adjustable expansion device relative to the expandable tubular member; and

a gripping device coupled to the locking adapted to controllably engage the expandable tubular member.

14. (New) The apparatus of claim 13 further comprising a locking device coupled to the actuator adapted to controllably engage the expandable tubular member.

15. (New) The apparatus of claim 13 further comprising a sealing device for sealingly engaging the expandable tubular member adapted to define a pressure chamber above the adjustable expansion device during radial expansion of the expandable tubular member.

16. (New) The apparatus of claim 13 wherein the gripping device comprises:

a tubular member having a plurality of tapered grooves defined on an exterior surface of the tubular member,

a retaining sleeve coupled to the tubular member and adapted to slidingly move longitudinally with respect to the tubular member, the retaining sleeve having a plurality of openings,

a plurality of gripping elements positioned within the tapered grooves, wherein when the retaining sleeve is in a first longitudinal configuration, portions of the gripping elements protrude through the plurality of openings, and when the retaining sleeve is in a second longitudinal configuration, portions of the gripping elements do not protrude through plurality of tapered openings.

17. (New) The apparatus of claim 13 wherein the anchoring device is a float shoe, comprising:

an expandable sleeve adapted to mate with the tubular member, wherein the tubular member is adapted to controllably expand the expandable sleeve to a larger outside dimension for radial expansion of the expandable sleeve to the expandable tubular member.

18. (New) The apparatus of claim 17 wherein the anchoring device comprises:

a first passage,

a second passage,

a seat within the first passage adapted to receive a plug,

a sliding valve disposed within the first passage, adapted to direct flow from the first passage to the second passage, and

a one-way valve coupled to the first and second passages.

19. (New) The apparatus of claim 13 wherein the anchoring mechanism is a packer.

20. (New) The apparatus of claim 13 wherein the packer is hydraulically actuated.

21. (New) The apparatus of claim 13 wherein the packer comprises:

a first passage,

a second passage,

a first seat within the first passage adapted to receive a plug, and

a sliding valve disposed within the first passage, adapted to direct flow from the first passage to the second passage.

22. (New) A method for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:

positioning an adjustable expansion device, an anchoring device, and a coupling mechanism below the expandable tubular member such that the anchoring device contacts a bottom of the borehole,

increasing the outside dimension of the adjustable expansion device; and

displacing the adjustable expansion device upwardly relative to the expandable tubular member to radially expand and plastically deform portions of the expandable tubular member,

displacing the anchoring device upwardly relative to the expandable tubular member such that the anchoring device contacts the bottom of the expandable tubular member,

coupling the anchoring device to the bottom of the casing,

uncoupling the adjustable expansion device from the anchoring device, and

displacing the adjustable expansion device upwardly relative to the expandable tubular member n times to radially expand and plastically deform n portions of the expandable tubular member.

23. (New) The method of claim 22, further comprising:

lowering the adjustable expansion device to couple the expansion device to the anchoring device, and cementing the borehole, wherein the cementing flows through a flow path located in the anchoring device.

24. (New) The method of claim 22 further comprising expanding an expansion device coupled to the anchoring device such that the anchoring device couples to the casing.

25. (New) An apparatus for radially expanding and plastically deforming an expandable tubular member, comprising:

an anchoring mechanism adapted to mate with an end of the expandable tubular member;

a tubular member releasably coupled to the anchoring mechanism,

an expansion device coupled to the tubular member adapted to be controllably expanded to a larger outside dimension for radial expansion of the expandable tubular member or collapsed to a smaller outside dimension;

an actuator coupled to the adjustable expansion device adapted to controllably longitudinally displace the adjustable expansion device relative to the expandable tubular member; and

a gripping device coupled to the locking adapted to controllably engage the expandable tubular member.

26. (New) The apparatus of claim 25 further comprising a locking device coupled to the actuator adapted to controllably engage the expandable tubular member.

27. (New) The apparatus of claim 25 further comprising a sealing device for sealingly engaging the expandable tubular member adapted to define a pressure chamber proximate the expansion device during radial expansion of the expandable tubular member.

28. (New) The apparatus of claim 25 wherein the gripping device comprises:

a tubular member having a plurality of tapered grooves defined on an exterior surface of the tubular member,

a retaining sleeve coupled to the tubular member and adapted to slidingly move longitudinally with respect to the tubular member, the retaining sleeve having a plurality of openings,

a plurality of gripping elements positioned within the tapered grooves, wherein when the retaining sleeve is in a first longitudinal configuration, portions of the gripping elements protrude through the plurality of openings, and when the retaining sleeve is in a second longitudinal configuration, portions of the gripping elements do not protrude through plurality of tapered openings.

29. (New) The apparatus of claim 25 wherein the anchoring device is a float shoe, comprising:

an expandable sleeve adapted to mate with the tubular member, wherein the tubular member is adapted to controllably expand the expandable sleeve to a larger outside dimension for radial

expansion of the expandable sleeve to the expandable tubular member.

30. (New) The apparatus of claim 29 wherein the anchoring device comprises:

a first passage,

a second passage,

a seat within the first passage adapted to receive a plug,

a sliding valve disposed within the first passage, adapted to direct flow from the first passage to the second passage, and

a one-way valve coupled to the first and second passages.

31. (New) The apparatus of claim 25 wherein the anchoring mechanism is a packer.

32. (New) The apparatus of claim 25 wherein the packer is hydraulically actuated.

33. (New) The apparatus of claim 25 wherein the packer comprises:

a first passage,

a second passage,

a first seat within the first passage adapted to receive a plug, and

a sliding valve disposed within the first passage, adapted to direct flow from the first passage to the second passage.

34. (New) A method for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:

positioning an expansion device, an anchoring device, and a coupling mechanism below the expandable tubular member;

displacing the expansion device upwardly relative to the expandable tubular member to radially expand and plastically deform portions of the expandable tubular member,

displacing the anchoring device upwardly relative to the expandable tubular member,

coupling the anchoring device to the bottom of the casing,

uncoupling the expansion device from the anchoring device, and

displacing the expansion device upwardly relative to the expandable tubular member n times to radially expand and plastically deform n portions of the expandable tubular member.

35. (New) The method of claim 34, further comprising:

lowering the expansion device to couple the expansion device to the anchoring device, and

cementing the borehole, wherein the cementing flows through a flow path defined in the anchoring

device.

36. (New) The method of claim 34 further comprising expanding an expansion device coupled to the anchoring device such that the anchoring device couples to the casing.

37. (New) A gripping device for gripping a wellbore casing, comprising:

a tubular member having a plurality of tapered grooves defined on an exterior surface of the tubular member,

a retaining sleeve coupled to the tubular member and adapted to slidingly move longitudinally with respect to the tubular member, the retaining sleeve having a plurality of openings,

a plurality of gripping elements positioned within the tapered grooves, wherein when the retaining sleeve is in a first longitudinal configuration, portions of the gripping elements protrude through the plurality of openings, and when the retaining sleeve is in a second longitudinal configuration, portions of the gripping elements do not protrude through plurality of tapered openings.

38. (New) An anchoring device for anchoring the position of a wellbore casing, comprising:

an expandable sleeve adapted to mate with the wellbore casing.

39. (New) An anchoring device for anchoring the position of a wellbore casing, comprising:

a housing,

a first passage defined within the housing,

a second passage defined within the housing,

a seat within the first passage adapted to receive a plug,

a sliding valve disposed within the first passage, adapted to direct flow from the first passage to the second passage, and

a one-way valve coupled to the first and second passages.

40. (New) A system for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:

means for positioning an adjustable expansion mandrel, an anchoring device, and a coupling mechanism below the expandable tubular member such that the anchoring device contacts a bottom of the borehole,

means for increasing the outside dimension of the adjustable expansion mandrel;

means for displacing the adjustable expansion mandrel upwardly relative to the expandable tubular member to radially expand and plastically deform portions of the expandable tubular member,

means for displacing the anchoring device upwardly relative to the expandable tubular member such

that the anchoring device contacts the bottom of the expandable tubular member,
means for coupling the anchoring device to the bottom of the casing,
means for uncoupling the expansion mandrel from the anchoring device, and
means for displacing the adjustable expansion mandrel upwardly relative to the expandable tubular member n times to radially expand and plastically deform n portions of the expandable tubular member.

41. (New) The system of claim 40, further comprising:
means for lowering the adjustable expansion mandrel to couple the expansion mandrel to the anchoring device, and
means for cementing the borehole, wherein the cementing flows through a flow path located in the anchoring device.

42. (New) The system of claim 40 further comprising means for expanding an expansion device coupled to the anchoring device such that the anchoring device couples to the casing.

43. (New) A method for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:

means for positioning an adjustable expansion device, an anchoring device, and a coupling mechanism below the expandable tubular member such that the anchoring device contacts a bottom of the borehole,

means for increasing the outside dimension of the adjustable expansion device;
means for displacing the adjustable expansion device upwardly relative to the expandable tubular member to radially expand and plastically deform portions of the expandable tubular member,
means for displacing the anchoring device upwardly relative to the expandable tubular member such that the anchoring device contacts the bottom of the expandable tubular member,
means for coupling the anchoring device to the bottom of the casing,
means for uncoupling the adjustable expansion device from the anchoring device, and
means for displacing the adjustable expansion device upwardly relative to the expandable tubular member n times to radially expand and plastically deform n portions of the expandable tubular member.

44. (New) The system of claim 43, further comprising:
means for lowering the adjustable expansion device to couple the expansion device to the anchoring device, and
means for cementing the borehole, wherein the cementing flows through a flow path located in the

anchoring device.

45. (New) The system of claim 43 further comprising means for expanding an expansion device coupled to the anchoring device such that the anchoring device couples to the casing.

46. (New) A system for radially expanding and plastically deforming an expandable tubular member within a borehole, comprising:

means for positioning an expansion device, an anchoring device, and a coupling mechanism below the expandable tubular member;

means for displacing the expansion device upwardly relative to the expandable tubular member to radially expand and plastically deform portions of the expandable tubular member,

means for displacing the anchoring device upwardly relative to the expandable tubular member,

means for coupling the anchoring device to the bottom of the casing,

means for uncoupling the expansion device from the anchoring device, and

means for displacing the expansion device upwardly relative to the expandable tubular member n times to radially expand and plastically deform n portions of the expandable tubular member.

47. (New) The system of claim 46, further comprising:

means for lowering the expansion device to couple the expansion device to the anchoring device, and

means for cementing the borehole, wherein the cementing flows through a flow path defined in the anchoring device.

48. (New) The method of claim 46 further comprising means for expanding an expansion device coupled to the anchoring device such that the anchoring device couples to the casing.

49. (New) A method of gripping a wellbore casing, comprising:

gripping the interior surface of the wellbore casing at a plurality of discrete spaced apart locations.

50. (New) A method of anchoring the position of a wellbore casing, comprising:

radially expanding and plastically deforming a sleeve within the wellbore casing into contact with the interior surface of the wellbore casing.

51. (New) A system for gripping a wellbore casing, comprising:

means for gripping the interior surface of the wellbore casing at a plurality of discrete spaced apart locations; and

means for actuating the means for gripping.

52. (New) A system for anchoring the position of a wellbore casing, comprising:

means for radially expanding and plastically deforming a sleeve within the wellbore casing into contact with the interior surface of the wellbore casing; and

means for controlling the means for radially expanding and plastically deforming the sleeve.

53. (New) A method of radially expanding and plastically deforming a tubular member, comprising:

pressurizing an interior portion of the tubular member; and

displacing an expansion device through the pressurized interior portion of the tubular member.

54. (New) The method of claim 53, wherein pressurizing an interior portion of the tubular member comprises pressurizing an annular interior portion of the tubular member.

55. (New) The method of claim 53, wherein displacing an expansion device through the pressurized interior portion of the tubular member comprises pulling the expansion device through the pressurized interior portion of the tubular member.

56. (New) The method of claim 53, wherein pulling the expansion device through the pressurized interior portion of the tubular member comprises using the operating pressure of the pressurized interior portion of the tubular member to pull the expansion device through the pressurized interior portion of the tubular member.

57. (New) A system for radially expanding and plastically deforming a tubular member, comprising:

means for pressurizing an interior portion of the tubular member; and

means for displacing an expansion device through the pressurized interior portion of the tubular member.

58. (New) The system of claim 57, wherein means for pressurizing an interior portion of the tubular member comprises means for pressurizing an annular interior portion of the tubular member.

59. (New) The system of claim 57, wherein means for displacing an expansion device through the pressurized interior portion of the tubular member comprises means for pulling the expansion device through the pressurized interior portion of the tubular member.

60. (New) The system of claim 57, wherein means for pulling the expansion device through the pressurized interior portion of the tubular member comprises means for using the operating pressure of the pressurized interior portion of the tubular member to pull the expansion device through the pressurized interior portion of the tubular member.

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